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FOREST EXPERIMENT STATIONS

By

EARLE H. CLAPP

Assistant Forester, Forest Service

UNITED STATES DEPARTMENT OF AGRICULTURE

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No one would think of abolishing the agricultural experiment stations in the United States. Their economic importance in the progress of agriculture is too well recognized. Functions similar to those of the agricultural stations make forest experiment stations indispensable to the progress of forestry and the welfare of the industries dependent upon the forests. American opinion is rapidly coming to the conclusion that national prosperity and well-being depend hardly less upon a bountiful and cheap supply of timber than upon a well developed and prosperous agriculture. This supply can be insured only by growing timber in the same way we grow farm crops.

The Forest Service, recognizing that forest experiment stations are needed to perform the same service in forestry that agricultural experiment stations render in agriculture, between 1908 and 1913 established six stations in the West—two in California and one each in Washington, Idaho, Colorado, and Arizona. A small technical staff was built up at each station. A program of investigations having to do with fundamental problems of forest management was laid out, and experiments requiring continuous prosecution for a term of years were inaugurated. The continuity of the work, however, was interrupted. Financial exigencies made it necessary to close the two California stations, and last year to reduce to a one-man basis all but one of the remaining stations. This involved suspending many of the studies that were under way and curtailing the rest severely. The situation for the current fiscal year is somewhat better, for it has been possible to renew the work of the Idaho station and to establish on a small scale two new eastern stations, one in the Appalachian Mountains and one in the southern pine belt. Nevertheless, the present provision for this form of research represents scarcely a beginning on a very large task.

A timber situation growing more critical yearly raises pertinent and important questions of what forest experiment stations have actually accomplished here and elsewhere, what they can and should do, the field they should cover, why they are necessary to the industrial and social development of the United States, how many we should have, where they should be, and what they will cost.

WHAT FOREST EXPERIMENT STATIONS HAVE DONE.

SHOWED HOW TO PLANT THE NEBRASKA SANDHILLS.

The traveler in central Nebraska, scanning from his Pullman window the dreary monotony of the sandhill landscape, is amazed to see it broken near the town of Halsey by the refreshing green of a growing forest. The Nebraska sandhills cover, all told, some 1,250,000 acres. They are not unlike the waves of a choppy sea, and are in slow movement before the prevailing winds from the northwest. The sparse native vegetation of bunch grass, shrubs, and other plants adapted to semiarid conditions retards but does not wholly check this movement. Here and there in the bottoms that wind among the hills the soil permits some field crops to be grown, but the hills themselves are almost pure silicious sand and scarcely more fertile than a sea beach. Live-stock grazing is the only form of use to which these great barrens in their natural condition could as a rule be put.

Something over 20 years ago a few thousand jack-pine seedlings were pulled up in the Minnesota forests and planted in these sandhills. To the surprise of everyone except the man who suggested the plantation, the trees survived and grew. It was at once assumed that afforestation here would be an easy task. An area was set aside as a National Forest. A nursery was established and planting operations were begun, but from 1903 through 1908 the results of plantation after plantation were so poor that foresters almost despaired of success. The plan of action was changed from trial and loss to systematic experiment and investigation. A trained scientist from the forest experiment station which had been established in the central Rocky Mountains a short time before was assigned to the task of finding out how to make forest plantations grow in the face of the difficult conditions presented. In two or three years the key, or rather keys (for the problem was complex), had been found. Nursery methods were developed that would produce more sturdy stock. The most favorable time for field planting was found to be a brief period, varying with the season, when the spring was far enough advanced to minimize the frost danger, yet not too late for adequate moisture. The unexpectedly wide variation of natural conditions between the sand ridges, south slopes, north slopes, and bottom lands within small distances was revealed, and the knowledge applied in the selection of the species best adapted to each site. For example, western yellow pine was found to be best suited for the pure ridge sands with their severe exposure to hard, drying winter winds, and jack pine for south slopes, where it was found that a tree must be able to start immediately after transplanting, while the soil moisture is still sufficient.

To-day the older plantations are already flourishing young forests, the soil is covered with leaf litter, natural seedlings have started, the native grasses have been shaded out, the bird life has changed, and Christmas trees are cut for local use. The practicability of reclaiming the entire region with a forest growth suitable for meeting local timber requirements has been fully established. The progress from barren sandhill to thriving forest is perhaps more strikingly shown by figures 1 to 4.

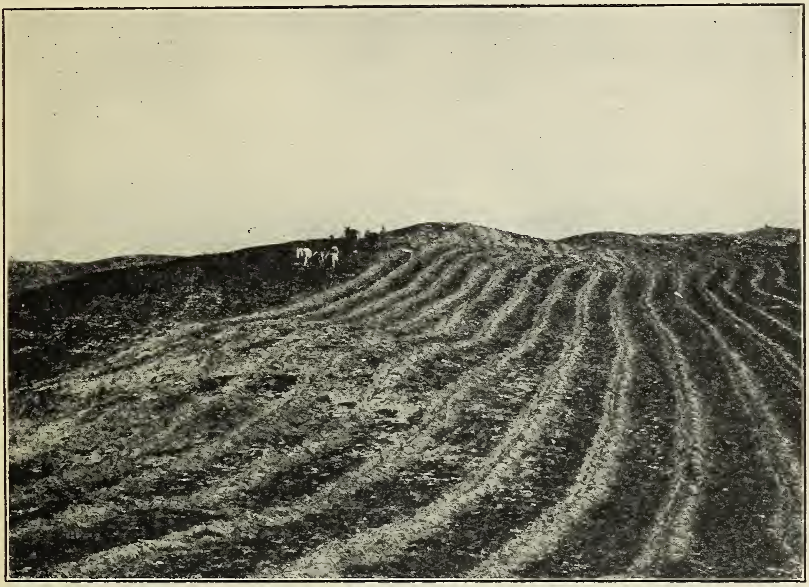

Fig. 1.—The Nebraska sandhills. Trees are being planted in each of the furrows. The barren character of the country is obvious.

SHOWED HOW TO PLANT IN THE WESTERN NATIONAL FORESTS.

The National Forests with their total area of 156,000,000 acres have two primary purposes—to provide permanent supplies of timber and to conserve water. To perform this service with full efficiency the vegetative cover on the watersheds must be brought into better condition. Before protection was inaugurated forest fires, overgrazing, and in some places destructive lumbering had done extensive damage. Tree growth had been partially or wholly destroyed on many millions of acres, and to secure reforestation of much of this land where the natural obstacles are greatest was one of the most difficult National-Forest problems.

For years the Forest Service fought with more energy than success to establish a forest growth on denuded portions of the National Forests in the more arid regions of the West. Thousands upon thousands of planted trees persistently refused to do anything but die.

Where the conditions were fairly favorable good results were obtained, but in most of the Southwest and in large parts of the entire region westward from the Great Plains to the crests of the Sierras and the Cascades the prospect of restoring forest growth through artificial planting seemed more and more dubious.

Here, as on the Nebraska sandhills, the plan of action was changed. Better knowledge of the obstacles and possible ways of surmounting them were sought through forest experiment stations. It is now possible to plant with reasonable success in the western yellow pine stands of the Southwest under conditions slightly, if any, less difficult than in the sandhills. The delayed germination of western white pine seed interfered with and increased the cost of nursery and planting operations for a number of years in the northern Rockies. The problem involved has also been largely solved, and in general reasonably successful planting methods are now known for our most common western species. Before the work of the western forest experiment stations had been so largely curtailed they had also made material progress in solving other problems essential to successful National Forest administration; and this in spite of the handicap of seriously inadequate personnel and equipment.

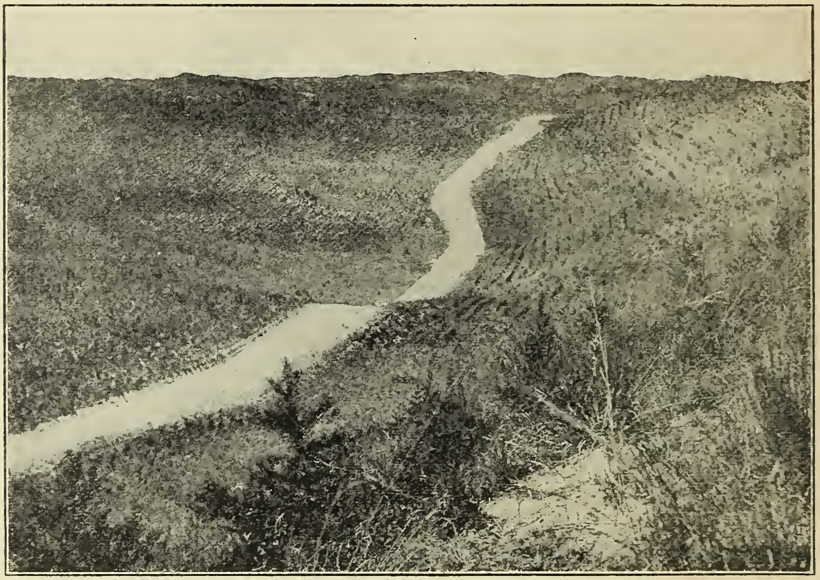

FIG. 2.—The trees are above the grass in a 5-year-old jack pine plantation in the Nebraska sandhills. The barren strip in the hollow is to aid in fire protection.

DEVELOPED METHODS OF CUTTING DOUGLAS FIR FORESTS.

Soon after the Forest Service took over the administration of the National Forests in 1905 it became necessary in selling timber to determine silvicultural methods for cutting the Douglas fir stands of the

Pacific Northwest. It was then thought that the needed information might be gleaned through general observations on private cut-over lands and old burns; but for a number of years the evidence there secured seemed to lead into a maze of conflicting indications. A forest experiment station was established in 1913 and this problem was one of the first assigned to its staff. It was found through the intensive investigations then instituted that sometimes splendid natural, even-aged stands of seedlings literally clothed the ground over thousands of acres after a fire in virgin timber. In the splendid reproduction following fires the distribution of the seedlings seemed to bear no relation to the location of the seed trees. The densest reproduction might be found, under circumstances which seemed to eliminate wind-carried seed, at distances of a mile from the seed trees, or much higher on mountain slopes, or with high intervening ridges. If seed trees were present a few seedlings might come in each year over a long period at comparatively short distances only from the parent trees. Reproduction sometimes but not always followed single fires. Abundant seedlings were found on some soils, and none on others. Reproduction was found after fires in virgin forests, but second fires and fires in young second-growth stands left a barren waste.

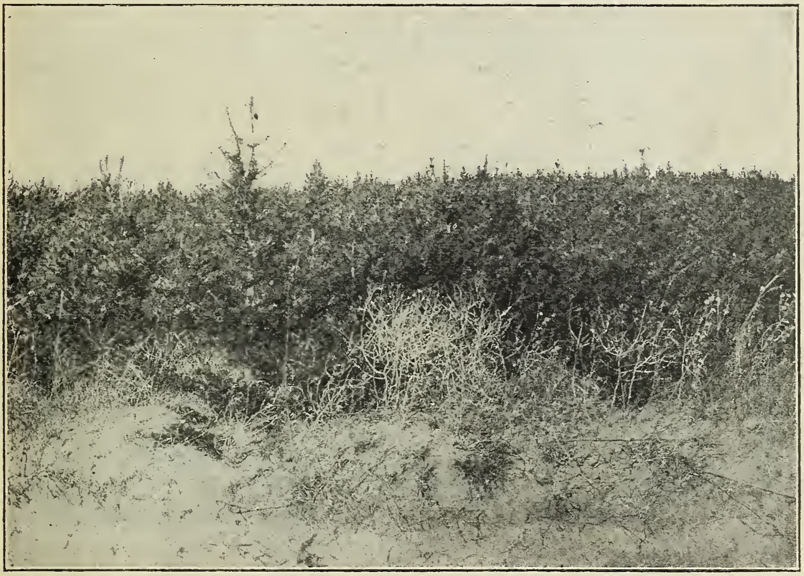

FIG. 3.—An 8-year-old jack pine plantation which covers the ground in the sandhills—11 years from seed.

Similar investigations were conducted on cut-over areas. Pacific coast logging operations in the characteristically large, heavy stands of timber leave at best an enormous mass of slash and débris which sooner or later burns. It was found that some burns were followed by excellent reproduction and others seemingly under the same conditions by no reproduction at all. Success or failure apparently did not depend upon the survival of seed trees. A slash fire immediately after logging was usually followed by reproduction; but if the fire occurred two or three years later the land became a barren waste. From these facts alone it was still impossible to decide what silvicultural method should be followed in cutting; whether seed trees were necessary, and if so, how many; and how slash should be disposed of.

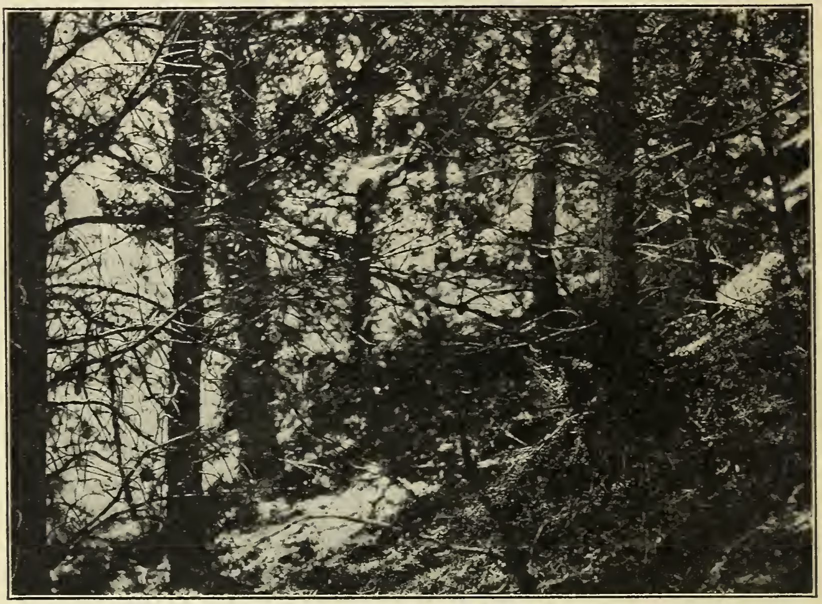

FIG. 4.—Trees of fence-post size in a 15-year-old jack pine plantation in the Nebraska sandhills. The soil is the same as in the preceding pictures.

The solution of the problem was found by the staff of the forest experiment station in a fact for the first time recognized in the annals of forestry in this or any other country—a peculiar and striking adaptation of nature which has perpetuated the magnificent fir forests of the Northwest notwithstanding the periodic occurrence of disastrous fires. In the duff of the heavy virgin stands enormous quantities of seed are stored, some of which retains its vitality over a number of years. When fire or cutting makes it possible for the sunlight to reach the ground the stored seed germinates, and seedlings by the thousands and millions begin their aggressive career, to hold the soil for their kind. If fire occurs after germination, the young seedlings are destroyed and nature's reserves are exhausted. It then becomes necessary to depend upon seed trees alone, and these seed up the surrounding areas very slowly and to comparatively short distances. If slash fires are very severe, the duff is largely or altogether consumed, and with it the seed necessary for a young stand. On cut-over areas, if a slash fire is delayed until after the stored seed germinates, the opportunity for prompt natural reproduction is lost.

In the discovery of seed storage lies the possibility of prompt natural replacement of the Douglas fir forests of the Pacific coast. There is still much to be worked out, but the direction which investigations must take has already been indicated, and, if they can be continued, it is only a question of time until the entire problem will be solved. The solution of this problem will determine whether we leave a heavy investment in seed trees, and how we dispose of slash. A new light is being thrown upon the entire question of fire protection. The forester realizes that he can no longer devote his efforts primarily to keeping fire out of virgin stands. Fires in stands too young to have deposited a reserve of seed on the forest floor mean artificial planting at high cost, and in the last analysis a monetary loss almost as great as that caused by fire in virgin stands.

SHOWED HOW FORESTS INFLUENCE STREAMFLOW AND EROSION.

Many other accomplishments of American forest experiment stations could be given which would make their place in forestry still more clear. It may, however, be well to ascertain whether the experience of other countries has coincided with that of our own. Europe, where forestry is centuries instead of decades old, affords many conclusive examples, one of which is selected because there have been numerous controversies in the United States upon the questions involved, and also because the results demonstrate the indirect benefits of forests. The work is that of the Zurich station on the effect of forests upon stream flow. Observations begun in 1900 upon two small watersheds, one wholly and the other one-third forested, were completed in 1918. The obvious purpose was to substitute knowledge for opinion on the question of the influence of forests upon stream flow. The results have the same significance for our Appalachians, Rockies, and Sierras that they have for mountainous Switzerland. Authoritative data were secured upon such factors in the two watersheds as soils; the kinds and permeability of the underlying rocks; the amount, character, and occurrence of the precipitation; erosion and landslides; and, finally, the amount, character, and variation of the run-off and stream flow in relation to all the other factors involved.

On a proportional basis the total annual stream discharge was approximately equal on the two watersheds. In short, heavy rain-falls the maximum run-off per second in the forested watershed was only one-third to one-half that on the lightly forested watersheds, and the total flood stage discharge usually one-half. Although, as a result of very long, heavy rains, the run-off was the same after the forest soil became saturated, the forest cover appreciably stabilized the stream flow and reduced the extremes of both high and low water. The forest cover was also beneficial in preventing landslides, which were common on steep, unforested slopes during heavy rains, and in preventing erosion, which greatly increases flood damage throughout the entire course of streams.

Many other findings, such as the comparative permanence of springs, the function of the accumulated débris or duff on the forest floor, the greater permeability of forest soils, the comparative evaporation from forested and nonforested lands, and the comparative effect of forest cover upon flow during rains of different intensity and duration, are also among the authoritative results from which the Swiss Republic can now determine whether its policy shall be to keep its mountain slopes in forest or open lands.

A similar investigation has been under way since 1910 in the comparatively light forests of the Colorado Rockies. If it can be completed, this investigation will furnish information of great value and significance for this and similar sections of the United States where agricultural development is dependent upon stream flow for irrigation.

MADE FORESTRY POSSIBLE UNDER ADVERSE CONDITIONS IN EUROPE.

As a result of research the growing of timber has become an accomplished fact under very adverse conditions in many parts of Europe. Experimentation made possible the reforestation of the French Alps. Erosion following deforestation had made the mountain slopes practically valueless, and the damage on the lower watersheds from excessive floods finally forced national action. The forests of the French Alps are now both highly productive and highly effective in regulating stream flow and preventing erosion.

Forest investigations also made possible the fixation of sand dunes along the French coast. After deforestation these dunes gradually moved inland, sometimes 10 miles or more, burying in their progress agricultural lands, orchards, houses, and even villages. The movement of the sand has been stopped and the dunes now produce a valuable forest crop.

Forest investigations made possible the reforestation of the Austrian Karst. Fire, deforestation, excessive grazing, and erosion had converted this originally productive region into a rocky desert. It now supports a luxuriant and valuable pine forest.

Through forest investigations the French Landes in a little more than half a century has been changed from one of the poorest to one of the most prosperous sections of France. Formerly swampy and malarial, it is now a health resort. It is the center of the world's second largest naval-stores industry. It supplies a large part of the mining timber needed by the Welsh coal industry. A prosperous agriculture has been made possible on the scattered farm lands from the largely increased returns through forests on the poorer soils.

It is only through forest investigations and the work of forest experiment stations that the prewar timber production in Saxony of 60 cubic feet per acre was possible, a production which netted $5.10 per acre to the State. Although practically every one of its forest regions is much more favorably situated than the forests of Saxony, the United States is producing less than 15 cubic feet per acre. The results of European stations can be duplicated in the United States.

WHAT FOREST EXPERIMENT STATIONS NEED TO DO.

The results described, striking and far-reaching though they are, indicate only in part the broad field of work which forest experiment stations should cover. The things they should do, the kind of questions they can and should answer, must be outlined in order to give a fuller understanding of their real place and of the need for them in any comprehensive forestry program.

TO DETERMINE WHAT KINDS OF TREES CAN AND SHOULD BE GROWN.

In forestry as in other forms of agriculture it is necessary to determine the crops for which any given land is best suited. One of the first questions which the forest experiment station will be called upon to answer is therefore likely to be for any specified area, what kind or kinds of trees can and should be grown? The answers will vary under different conditions of soil, drainage, altitude, and climate in every forest region of the United States from New England to the Pacific Northwest and from the Lake States to the Gulf of Mexico. We have 495 species, of which 125 are commercially important, and all differ in their life histories, characteristics, and requirements. Our problem is further complicated by a large number of variations in the combinations of species in forest stands.

TO FIND OUT HOW TO PLANT.

When, in spite of the efforts of nature, man has entirely destroyed the forest, as on some 81,000,000 acres in the United States to-day, artificial reforestation becomes necessary. The kind of urgent and practical question which at once arises is illustrated by the sandhills planting already discussed. Nothing is known of the species. The plantation of 10 or 100 or 1,000 acres after one season has 10 per cent of healthy survivors. What is the cause of the failure, which represents $150, or $1,500, or $15,000? Was it poor seed, or poor nursery stock, or improper planting, or planting at the wrong time of the year? Or was the year exceptional? How can the cause of the failure be ascertained and how can the same mistakes be avoided? Perhaps the seedlings reach 25 feet in height after 20 years and then most mysteriously slow down and finally stop growing. What is wrong? All of these things have happened in the United States and will happen again unless the information needed to prevent them is obtained through experimental work. Mistakes run rapidly into time and money and idle, unproductive land.

TO DETERMINE BEST METHODS OF CUTTING AND SLASH DISPOSAL.

Perhaps an owner has a tract of cut-over, fire-swept, ragged forest from which the better species—the oaks, walnut, and yellow poplar, if it happens to be in the hardwood region—are largely or altogether culled. We have an enormous aggregate of such lands in the United States to-day. What processes must be employed to bring such an area into good growth of desirable species at least time and expense? Or, it may be that the owner must deal with a fine virgin stand of mixed hardwoods of from 5 to 20 species, from which he desires by lumbering to obtain the maximum present return consistent with the perpetuation of the forest. What cutting can be allowed? Will reproduction be secured from seed trees? How many are necessary per acre? How must they be left to avoid windfall? If the slash is left, how long will it be a fire menace? Will it rot down in 3 years, or will 20 be required? If it is to be burned, what special provisions are necessary?

Perhaps we have to do with a stand of western yellow pine growing under adverse climatic conditions. Many trees are covered with mistletoe. If left in cutting, will they bear fertile seed? Will they live until a second cutting is possible, perhaps 40 years hence, or must they be cut now in order to be salvaged? Other trees have dead tops or are stagheaded. How long will they live? Will they grow? Should they be left or should they be cut?

TO ANSWER MANY QUESTIONS CONCERNING FOREST MANAGEMENT.

Heavy sheep grazing prevents reproduction in a western yellow pine forest. Must sheep be excluded, and for how long? Or may grazing be so regulated that it may safely be continued? As shown by figures 5 and 6, the same questions may arise in connection with hog grazing.

We have a stand of long-leaf or slash pine in the South. What trees may be cupped and how may the maximum of naval stores be secured and the forest still kept productive? What methods of management must be followed in the southern Appalachians to prevent erosion and floods, and what methods in the Rockies and in southern California to furnish a maximum of stream flow for irrigation? These merely illustrate the wide range of difficult questions which must be answered if forest management is to be effective.

TO ASCERTAIN GROWTH AND YIELDS.

A pulp and paper company in the spruce region of the Northeast, with a $5,000,000 investment in a manufacturing plant, with a daily newsprint paper capacity of 100 tons, already owns 50,000 acres of forest land and is dependent upon purchases in the United States and Canada for two-thirds of its pulpwood. The company is dubious concerning the possibility of indefinite imports and forsees the exhaustion of American supplies. It has therefore decided to protect its investments by enlarging its own holdings to the extent necessary to supply its plant indefinitely. It must know how many years will be required to grow timber of pulp size most cheaply; what yields may on the average be depended on; what acreage will be required; and, as nearly as possible, what forest replacement, natural or artificial, with taxes, protection, and land investment will cost with compound interest at the time the crop matures. These are not hypothetical questions; many pulp and paper companies in the East

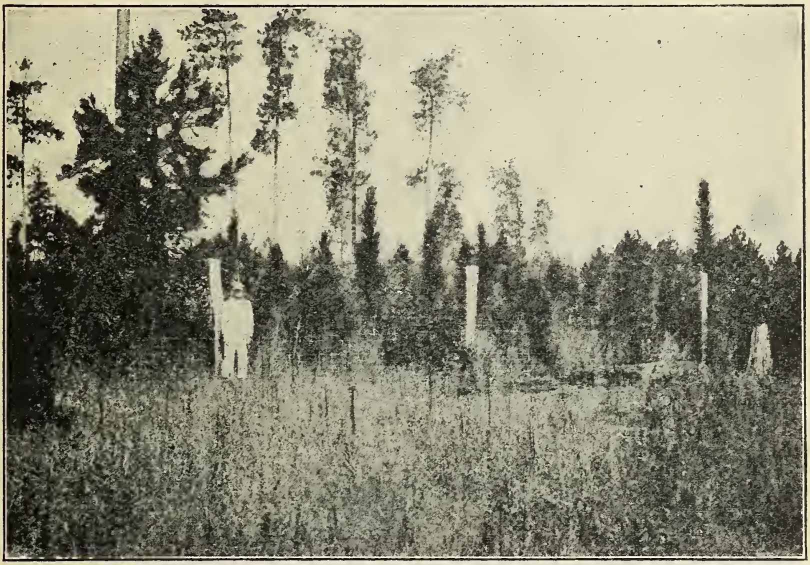

FIG. 5.—An investigative area in Louisiana. Fine young longleaf pine inside the fence which has kept out the razorbacks. Outside there is nothing. Fires have been kept out.

are seeking answers to them to-day. The same questions as to the rate of growth, size at different ages, quality at different sizes, and yields per acre at different ages on different soils, confront every private or public owner at the first consideration of the practice of forestry in every region and with every species and combination of species. This kind of information is basic in the financial plans and policies of the owner.

TO ESTABLISH THE BASIS FOR IMPROVED METHODS OF FIRE PROTECTION.

In American forests protection from fire looms large. The growth of 50 years or even two or three centuries may be wiped out in an hour. Not all phases of fire protection lend themselves to investigative efforts, but the investigator can, for example, determine what conditions of climate, from the standpoint of protection, are most significant for each region; whether it is possible to predict adverse conditions; what important phases in the behavior of fires must be known for effective fire protection and fire fighting; and how great the damage from fires really is as a basis for deciding how much protection there should be.

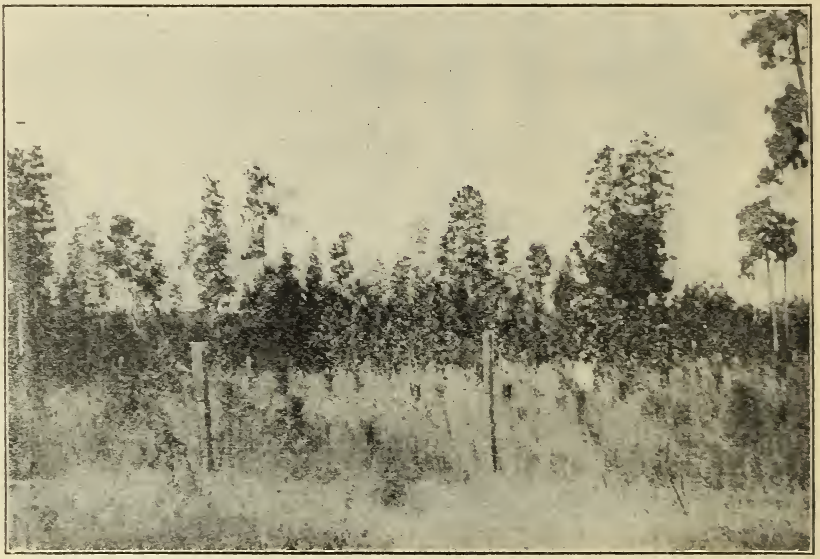

FIG. 6.—Same conditions as in figure 5, but fires have reduced the number of longleaf-pine seedlings and greatly retarded their growth.

TO COOPERATE IN FOREST MANAGEMENT PROBLEMS CLOSELY RELATED TO WOOD UTILIZATION.

Many problems connected with the growing of timber which should be studied at the forest experiment stations are closely related to problems connected with the most effective utilization of timber and other forest products which are studied at the Forest Products Laboratory. For example, naval-stores production involves questions of forest management which are closely related to such exploitation problems as the age and size of trees to be cupped, the best operating methods, yields under different methods and conditions, and the effect of turpentining upon the structure and properties of the timber and its suitability for subsequent utilization. A wide field covering the relation between growing conditions and wood structure and properties, and hence of direct concern both in effective forest management and in the utilization of wood, can be investigated satisfactorily only by the two agencies in cooperation. Problems of this character will become increasingly numerous and important as the country becomes more and more dependent upon second-growth timber. The establishment of forest experiment stations will, therefore, make possible the cooperative investigations which will cover the entire field of timber growing and utilization.

TO FURNISH THE SCIENTIFIC BASIS FOR FORESTRY.

To sum up, the field of forest experiment stations includes: Dendrology or forest botany, to work out the distinguishing characteristics of our many forest trees and their geographical distribution; the entire range of forestation, from the production, collection, extraction, cleaning, testing, and storage of seed to nursery practice, field planting, and direct seeding; silviculture proper, or methods of cutting, including intermediate cuttings or thinnings; forest protection, particularly from fire; utilization of other products than wood, such as naval stores and forage; forest management, or the regulation of the cut, together with its basis of data on volume growth and yields; forest influences, or the effect of forests upon stream flow, erosion, and even upon climate; cooperation in closely related management and utilization problems. Underlying all these investigations must be studies of the life history of individual species and of the fundamental natural laws governing tree growth. The relationship between forest regions, forest types, forest sites, and forest trees, and the climatic and physical factors affecting their distribution and growth must be worked out and thoroughly understood.

What forest experiment stations should do, therefore, is to establish in the shortest time and in the cheapest, most effective, and most authoritative way the entire technical and scientific basis for the growing and protection of timber. Furthermore, the stations may be made to serve as demonstration areas to show the results of successful methods. Their value for demonstration purposes is hardly less than for research.

WHY WE NEED FOREST EXPERIMENT STATIONS.

Merely to outline what forest experiment stations can and should do is in itself to go a long way toward justifying them, but there are other and broader considerations. Some of these considerations are essentially the economic justification for forestry itself.

TO SUPPLY OUR INDUSTRIAL REQUIREMENTS.

Timber growing and the manufacture, distribution, remanufacture, and consumption of forest products affect our entire population. Timber growing as an industry has hardly begun except on the National Forests and on a few State holdings, but in 10 or more important forest regions throughout 39 States 20 or more industries begin operations with the standing tree and utilize lumber as their chief raw material. There is hardly a railroad line in the United States that is not concerned in distribution. Many steamship lines also distribute forest products, and a large number of wholesale and retail firms are organized in part or altogether for their sale. Agencies engaged in distribution and remanufacture are found in every part of our 48 States, and consumption extends still farther. Not considering industries using lumber as such, some 55 industries, with widely varying and more or less exacting requirements as to kinds of timber, quality, and amounts, use lumber in the manufacture of a still greater number of other products. Lumber utilization ranges from general millwork and planing-mill products—buildings, crates and boxes, vehicles, railroad cars, furniture, agricultural implements, and woodenware—to a practically endless variety of objects, small and large, luxuries and necessities. We manufacture and utilize some 275 classes of paper, including box board, newsprint, building papers, various fibers, book papers, and numerous specialty papers, and many of these classes are divided into grades. Still further ramifications in the manufacture and use of other forest products, such as naval stores and the materials secured by wood distillation, could be cited to illustrate the innumerable ways in which these products ultimately reach and serve our entire population.

Forest experiment stations are needed to study ways and means of supplying these numerous products and supporting this wide range of industries and consumers. They are needed if we intend to supply in perpetuity our normal lumber cut of thirty-five to forty billion board feet. They are needed to make possible a gradual increase in the cut for pulp and paper, which now totals four and one-half million cords and falls short by one-fourth of meeting current requirements. They are needed also to supply the extremely varied requirements of a large number of our producing and consuming industries for such products as poles, piling, cooperage, and veneer—a grand total for all these purposes of twenty-four and one-half million cubic feet of wood each year.

TO PREVENT ECONOMIC DISTRESS.

Forest experiment stations are needed to ascertain how to produce this volume of wood and thus prevent the economic distress which will result from shortages. The experience of 1920 is an indication of what to expect. When our 1906 per capita lumber consumption of 515 board feet had been reduced to 300 feet in 1918 and subsequent years, the housing crisis was one example of what a lumber shortage means in reduced standards of living. In the face of a shortage of 1,000,000 homes, with repairs and construction of all kinds greatly delayed, the average American can not now contemplate with complaisance a still further reduction in lumber utilization to the 150 board feet per capita of prewar Germany or the 120 board feet of England. Short supplies and large demands resulted in the excessive lumber prices of the first six months of 1920. The available supplies went largely for luxuries to the detriment of the necessities. Lumber was purchased by industries in a position to pass on excessive costs to the ultimate consumer; and industries which could not do so suffered severely in competition. The economic distress growing out of shortages of supply and excessive prices was by no means confined to lumber. Pulp and paper, and naval stores, as well as other forest products, had their own crises, involving in difficulties more or less serious a long list of industries and many classes of consumers.

TO AID IN THE DEVELOPMENT OF BOTH PUBLIC AND PRIVATE FORESTRY.

The forest needs of the country can be met only through a combination of public and private forestry. Only about one-fifth of our forests are publicly owned. Something more than 97 per cent of the present timber cut is taken from privately owned lands. To propose that our timber requirements be provided for through public acquisition of some hundreds of millions of acres of forests in private ownership, with the consequent nationalization of substantially the entire business of timber production and utilization, is a fantastic and chimerical remedy for a practical and immediate situation. The burden upon public treasuries by such action would be far too great. If the public expects private owners to practice forestry, it must expect also to bear a large share of the burden of the forest research which alone can develop the methods that will insure success in timber growing. The fact that successful methods of timber growing are known and have been demonstrated will in itself constitute a powerful stimulus to the development of private forestry. Even the public forests can not be handled properly without better knowledge than has yet been obtained.

TO GROW OUR ENORMOUS WOOD DEFICIT.

We have already cut or burned over five-sixths of our original timber area of 822,000,000 acres. Three-fourths of our total utilization and practically all the high-grade material is still from virgin stands. We can not indefinitely use or destroy 26,000,000,000 cubic feet each year and grow only 6,000,000,000. We shall soon have to grow a much larger part of the 20,000,000,000-foot difference, and possibly within a single generation we shall have to grow all the timber we use unless we are satisfied to be dependent upon foreign countries, with the drastic limitations in amounts and the excessive prices this will impose. Forest experiment stations are needed to find out and demonstrate how to grow this enormous volume of wood.

TO MAKE IDLE LANDS PRODUCTIVE.

Forest-experiment stations are needed to make land productive which otherwise would not be used. This function has particular significance when we are adding from 8,000,000 to 10,000,000 acres each year to the 81,000,000 acres already wholly waste, but capable of large production, and when we have 245,000,000 acres for the most part producing much less than their capacity in both quantity and quality. No time should be lost in learning methods to keep fully productive the 137,000,000 acres of virgin stands which we still have left. We have the opportunity to utilize a total of 463,000,000 acres of forest land in the production of wealth, for the support of a large timber-growing industry comparable to farming, and for the maintenance of other large industries which involve logging and the primary manufacture, transportation, and remanufacture of forest products. Our agriculture can be diversified by utilizing poor land for profitable timber crops. In fact, through a combination of timber production and agriculture, farming can be made successful in many regions where otherwise it could not exist.

TO ESTABLISH THE SCIENTIFIC BASIS FOR FORESTRY MOST CHEAPLY AND EFFECTIVELY.

The questions that relate to planting and cutting, yield and management, may be answered slowly and unsatisfactorily by administrative trial, or cheaply and authoritatively by research. Under the former method large areas are involved. Costs are high, particularly if mistakes are made. It may not be possible to correct a mistake during the lifetime of a single forest crop covering 25 to 150 years. In research, varying methods are tried out on a small scale by trained observers, and successful methods are determined and demonstrated. Methods which prove unsuccessful are on a small scale, and each thorough analysis of causes teaches fully its lesson. One hundred seedlings may be planted on an area under methods which prove to be unsuitable. Large-scale, costly mistakes are avoided. Trained technical men are on the ground to see what happens, and how and why. Fact replaces guess and opinion. European experience and our own has shown that investigations such as these can best be conducted at forest-experiment stations. These stations therefore need to be established and maintained as a measure of national economy. They will furnish the entire scientific basis for forestry in the shortest time and in the cheapest, most effective, and most authoritative way.

TO PUT FORESTRY ON THE SAME EXPERIMENTAL BASIS AS AGRICULTURE.

Like agriculture, forestry in the United States is a basic industry and must underlie and support all other industries. Both utilize land in the continuous production of necessary materials. Food and clothing are but little more essential to our present-day civilization than the wood which in one form or another enters into practically every human activity. The forest experiment station is as necessary to forestry as the agricultural station is to agriculture. The relations are identical. Just as the agricultural station, for example, must develop methods for dry-land farming, so must the forest experiment station develop methods for timber production in the sandhills. Comparisons could be multiplied indefinitely. Both show the means for producing maximum crops of the desired kinds—on the farm the growth of a single season, in the forest the production of decades or of a century. Both aim at the greatest production of wealth per unit of effort and per unit of land.

The country probably has a fair appreciation of the need for agricultural experiment stations to increase the production of farm crops. We have cooperative State experiment stations in each of our 48 States, to which the Federal Government contributes almost a million and a half dollars a year. Direct Federal expenditures for agricultural research exceed an additional $7,000,000. We contribute almost $200,000 annually to the support of agricultural experiment stations in our insular possessions. Approximately one-fourth of our total land area, or 463,000,000 acres, is forest land. Expenditures for agricultural experiment stations and research are used largely on improved lands, the area of which, 478,000,000 acres, is only slightly in excess of that of forest lands. In 1918 the values of agricultural and of forest products in the United States were approximately $12,500,000,000 and $1,300,000,000, respectively, or in the ratio of 9½ to 1. But in determining methods for the growing of timber, basic to our industries in the same way that agriculture is basic, the Federal Government during the fiscal year 1921 expended $50,000, and during the fiscal year 1922 will expend $85,000. Expenditures for agricultural stations and research for the fiscal year 1921 approximated $8,500,000, or one hundred times the amount available for forest experiment stations in 1922. The preceding relationships are shown graphically in figure 7.

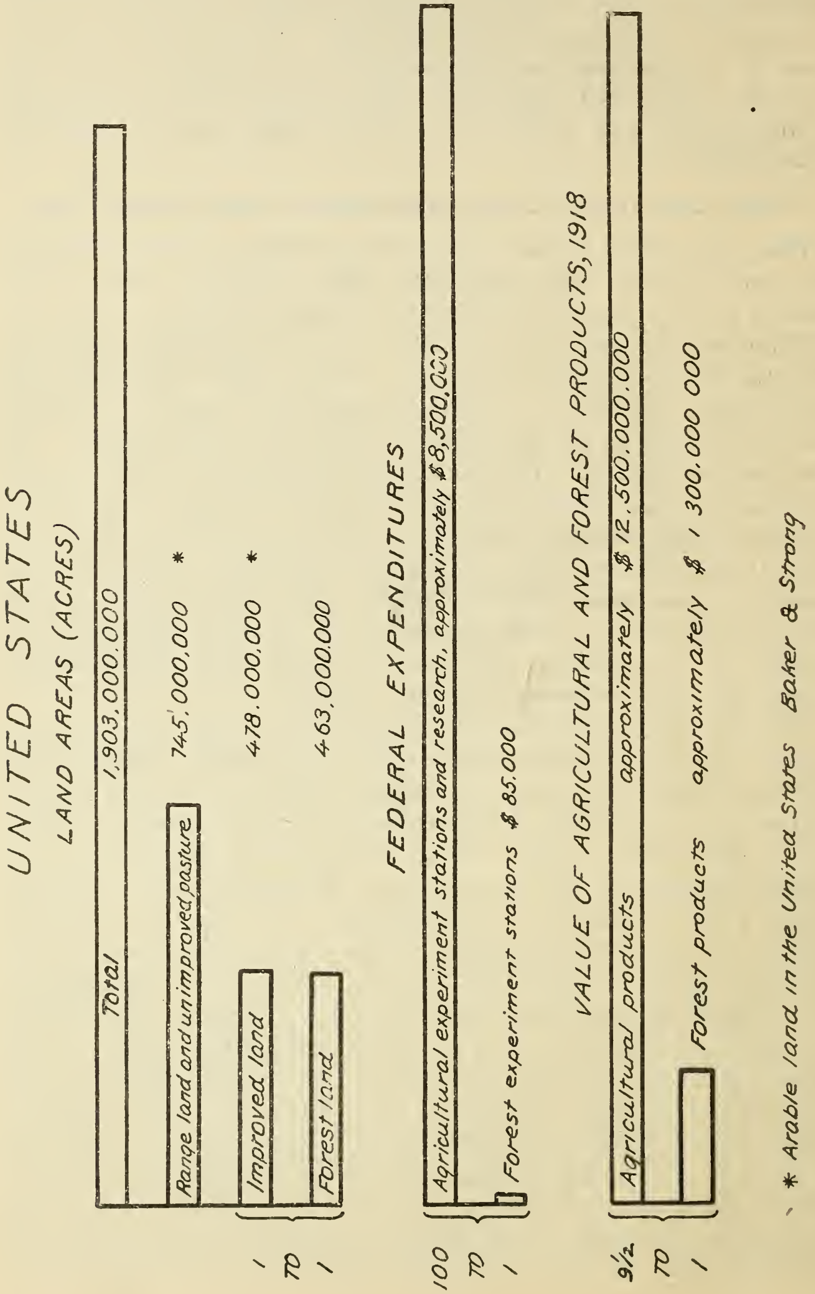

FIG. 7.

WHERE FOREST EXPERIMENT STATIONS ARE NEEDED.

At least one forest experiment station is needed in each of the principal timber regions of the country—a total of 10—5 in the East, 3 in the Rocky Mountains, and 2 on the Pacific coast. In addition to their own direct contributions these stations can, through cooperation and otherwise, greatly stimulate forest research by States, forest schools, and all other agencies in the United States.

IN THE EAST.

SOUTHERN PINE BELT.

A forest experiment station is needed in the southern pine belt, because this is and can be continued as the largest and one of the most important forest regions in the United States. The present area of 115,000,000 acres of pine forests alone is equal to one-half of the combined forest area of all European countries except prewar Russia. The station must deal with several species, of which longleaf, shortleaf, loblolly, and slash pines rank among our best and most important general construction timbers. Longleaf and slash pine are also the source of the American naval-stores industry. The problems of the cypress forests and also those of a very considerable area of hardwood forest intermingled with pine and cypress demand consideration.

A few of the most important facts indicating the need for a southern station are:

The original southern pine forests occupied one hundred and twenty-five to one hundred and thirty million acres.

The present area of virgin timber is only twenty-three and one-half million acres.

The present area of waste forest lands is 30,000,000 acres.

Four-fifths of the original 650,000,000,000 feet have been cut since 1870, chiefly since 1890.

The normal pine cut has been 15,000,000,000 out of a total of 40,000,000,000 feet for the United States, but the crest of production has already been passed.

Other sections of the United States are even more interested than the South in continued production, since two-thirds or more of the total cut for the past 20 years has been the main source of supply to the great eastern and middle western markets.

By 1930 increased local demands promise to take all of the decreased cut, leaving the rest of the country dependent upon the Pacific coast.

The Florida citrus industry, which consumes 13,000,000 boxes annually and is planning to treble its output in 10 years, is apprehensive as to the future and is considering California as a source of wood supplies.

The naval-stores industry of the United States, whose production is still 80 per cent of that of the entire world, in spite of a decrease of 50 per cent or more during the last 20 years, will within 10 years supply no more than American requirements.

World leadership in naval-stores production is passing to the artificially established maritime forests of France.

Less investigative work has been done in the South than in any other important timber region. That done, as in most eastern regions, has been general in character, and the time has come when little more can be accomplished except by the intensive investigations possible at a forest experiment station. An adequately manned and equipped forest experiment station is needed in the southern pine belt to show how to bring back into production 30,000,000 acres of waste forest land, and how to increase production on 60,000,000 acres additional which for the most part is now growing much less than it should. A station is needed to develop methods of cutting which will keep twenty-three and one-half million acres of virgin pine stand fully productive. In addition to the solution of the problem of artificial reforestation and the development of methods of cutting which will insure natural reproduction, it must develop effective methods for the care and protection of young stands from fire. Methods must be worked out which will permit grazing in connection with timber growing. Better practices in turpentining must be developed to permit maximum yields of naval stores with the minimum of damage to growing stands. Data on the growth and yields of different species under different conditions will be needed by all forest owners. The work of the station should be, in short, to cover all of the problems involved in the management of the forests from the seedling to the mature stand. Similar work is also necessary in the cypress and hardwood forests of the Gulf States.

LAKE STATES.

The past of the Lake States as a timber region is too fresh to require comment, but the great future possibilities of timber production are rarely considered. A Lake States forest experiment station should work on problems connected with the highly important white pine forests and those of hemlock, spruce, and the northern hardwoods—beech, birch, and maple. It should work also on problems connected with the jack pine and aspen forests, which now seem certain to play an important part in the forestry of the region. The supposedly inexhaustible white-pine supplies in the Lake States cut a maximum of nearly 9,000,000,000 feet in 1892, but production has now fallen, in 1921, to approximately 1,000,000,000. The present total cut of about three and one-half billion feet of all species promises to fall further by nearly one-half within the next 10 years. Wisconsin, which led the country in lumber production in 1900, now produces less white pine than the second-growth cut of Maine or New Hampshire; and Michigan, for 25 years our leading State in lumber production, now cuts less than half as much white pine as Massachusetts. One-third of the 800,000 cords of pulpwood consumed in Wisconsin is reported as coming from outside the State. On much of an area of 20,000,000 acres devastated by destructive logging methods and repeated fires there is now little chance for a new forest except through artificial measures. Of 12,500,000 acres that produces only cordwood, and of 14,000,000 acres now growing young saw timber, only a small percentage is producing anything like the amount possible of either.

By solving questions of reforestation, cutting, growth and yields, protection, and similar problems, a forest experiment station could assist in stimulating the production of saw timber in the Lake States to a point where at least local requirements would be met. This is hardly too much to expect from a region which not more than 25 years ago supplied almost the entire United States, and was, in addition, an important factor in world markets. The production of pulpwood for an important section of our pulp and paper industry is hardly less urgent. Production must be stimulated in extensive commercial forests; but the farm wood lot, if properly managed, can be made to serve an important place in the timber production of the region. An excellent opportunity exists for cooperation on the part of the Federal Government with State and other agencies which are already in the field doing work which is admirable in quality but very inadequate in amount.

NORTHEAST.

A third forest experiment station is needed to work on the problems of New England and northern and eastern New York, a region in which the Federal Government is now doing no investigative work. For New England alone it will have to solve the forestry problems of nearly 25,000,000 acres of forest lands, of which 5,500,000 acres is now an unproductive waste and more than 8,000,000 acres grows nothing but fuelwood, much of the remainder producing only a part of its capacity.

There are other important facts which amply justify a northeastern experiment station.

New England produces 30 per cent of our newsprint, and New York 50 per cent. Maine is the leading State in pulp production.

New England produces 15 per cent of the boxes of the country.

New England's agricultural products are $20,000,000 less in value than the products of its wood-manufacturing industries. It has seven agricultural experiment stations.

The American pulp and paper industry, centered largely in the Northeast, imports one-fourth of its pulpwood from Canada and an additional percentage of pulp.

New York imported more than one-half of the 1,130,505 cords of pulpwood it consumed in 1920.

Already a large percentage of the northeastern pulp and paper manufacturers are totally dependent on the purchase of pulpwood, and only a small percentage are entirely independent.

The rapid expansion of the Canadian industry threatens to extend to private lands the pulpwood embargo already in effect on crown lands in several provinces.

New England imports half its lumber, and New York cuts less than half of its requirements.

A northeastern forest experiment station must therefore work on the problems of spruce and other forests, important primarily from the standpoint of pulpwood production, and upon the problems of the white-pine and hardwood forests, which in both New England and New York should supply a large percentage, if not all, of the requirements of the local industry. These problems, already complicated by greatly diversified forest conditions, are made still more difficult because of the devastations of the gypsy and browntail moths, the white pine blister rust, and the chestnut blight. Commercial tracts of considerable size will continue to be a large factor in timber growing; and the farm woodlot throughout the Northeast, by the full utilization of its soil, can be made to produce vastly larger timber crops, and thus materially supplement and stabilize agriculture.

That the productivity of New England timberlands may be greatly increased through better handling is perfectly evident from the progress already made in this direction on the National Forests and on a few private tracts. In no other region of the United States are economic conditions more favorable for the practice of forestry by public or private owners. Large markets are only a few miles from the forests. Because of large investments in plants, pulp and paper concerns will, if necessary, pay high prices for raw materials. Utilization can often be as complete as under intensive European practice.

ALLEGHENY MOUNTAINS.

A fourth station is needed to work on the forest problems of Pennsylvania, southern and western New York, Ohio, Maryland, New Jersey, and Delaware—still another eastern forest region where now the Federal Government is conducting no forest investigations. The forests of this region from the standpoint of cut were once the most important in the United States. Pennsylvania, which in 1860 led the country in lumber production and as late as 1880 was the second State, is now, through forest devastation, no longer able to supply more than one-fifth of its own requirements.

One-seventh of the area of Pennsylvania—over 4,000,000 acres—is now practically waste because of the fires and floods that followed in the wake of lumbering.

Several counties in Pennsylvania, formerly rich in forests and prosperous, are now reduced almost to bankruptcy because the timber is gone.

Pennsylvania imports four-fifths of all the lumber it uses. It costs the citizens of the State approximately $100,000,000 a year to bring timber from the outside that might better be grown within its borders. The Pittsburgh district alone consumes more lumber than is produced in the whole State.

The denuded and waste lands at the headwaters of the Allegheny River now cover an area of over half a million acres, having nearly doubled in size during the past 10 years. This is believed to be the largest acreage of barren hardwood land in one body in the eastern United States. Such conditions favor disastrous floods.

Ohio is one of the leading States in the wood-manufacturing industries, yet much land in the southern portion of the State is unproductive as a result of wasteful cutting and subsequent fires.

The forests of New Jersey are badly depleted. As a result of misuse they are yielding the owners a yearly net revenue of about 50 cents per acre. New Jersey is using about 20 times as much timber as is being grown in the State.

The forests of Maryland are being used at a rapid rate. While growth adds about 2 per cent, lumbering takes away about 10 per cent of the stand yearly. The total lumber cut in 1918 had shrunk to less than one-half that of 1910.

The Allegheny forests are intermediate in character between those of the Northeast and those of the Appalachian Mountains, and present a distinct set of problems. In addition to the reforestation of denuded lands, the most important problem is the conversion of stands occupying millions of acres, which through fire and other destructive agencies have been brought to a stage in which there is practically no timber production, into highly productive forests of valuable species. The steep mountain slopes of much of Pennsylvania are suited primarily for timber production and are so accessible to market that utilization comparable with that of Europe can even now be obtained in many localities. Increased production upon farm woodlots of Pennsylvania and the surrounding States can be made a valuable adjunct to agriculture. In addition to timber growing, the forests of the mountainous sections can be made by proper management to render a valuable service in watershed protection and the regulation of streamflow. These are merely a few of the reasons which justify a forest experiment station.

APPALACHIAN MOUNTAINS.

Not least in importance among the eastern forest regions requiring forest experiment stations is the Appalachian Mountain region, upon which the United States has for many years depended for a large part of its hardwood supply. Except for widely scattered farm woodlots and comparatively small areas in the Lake States and the Northeast, the entire country will in the future have to depend upon the steep mountain slopes of the southern Appalachians for a very large proportion of its high-grade hardwood supplies. The bulk of the remaining hardwood stand is now in the lower Mississippi valley, and most of this rich bottom land will undoubtedly be used for agricultural purposes when the timber is removed. The future of some of our most important industries, such as furniture, cooperage, tannin manufacture, vehicles, and agricultural implements, is at stake.

Appalachian hardwood production fell off nearly 60 per cent between 1909 and 1918. Oak production decreased from 2,200,000,000 to 780,000,000 board feet.

Yellow-poplar production for the United States, centering largely in the Appalachians, fell between 1909 and 1918 from 1,115,000,000 to 290,000,000 board feet; ash from 291,000,000 to 170,000,000 board feet; and hickory from 334,000,000 to 100,000,000 board feet.

The North Carolina hardwood cut fell from more than 400,000,000 in 1909 to less than 200,000,000 board feet in 1918. From 90 to 100 per cent of the furniture, vehicles, and chair makers of the State have experienced a great reduction of local supplies during the last 10 years.

Well-informed lumbermen predict that large-scale production in West Virginia, the first State in hardwood production from 1910 to 1917, will not exceed 10 years; and that most of the large mills of the State will have cut out in 5 to 8 years; also that the old-growth timber will be exhausted in 20 to 25 years in the southern Appalachians.

The Appalachian region has 30,000,000 acres of mountainous forest lands and a larger area in adjacent territory most suitable for timber growing because of topography or soil, a total that is approximately twice that of the forest area of prewar Germany.

An Appalachian forest experiment station will have to cover the problems of a large number of valuable species, including 10 or more oaks, several hickories that have no known foreign equivalents, yellow poplar, basswood, black walnut, and cherry—specialty woods of high value—several valuable ashes, chestnut, and a number of other hardwoods. Within this region are also a number of coniferous species, as, for instance, the northern white pine and spruce, and a liberal representation of the southern pines.

For those species which occur under widely varying conditions, and in a large number of combinations, such problems as the following must be studied: The conversion of the extensive cut-over, fire-damaged, and relatively unproductive forests into rapidly growing forests of the best species; methods for replacing the widely distributed chestnut forests which are now being rapidly killed by the chestnut blight, chestnut often forming as much as 60 per cent of the hardwood stands; a wide range of questions underlying protection from fire, and the relation of grazing to forest growth and reproduction; methods of management which will afford the greatest protection to municipal watersheds, the greatest regulation of stream flow, and prevention of erosion; the quantity of timber that can be grown of different species and combinations of species under varying forest conditions as a basis for both National Forest and private policy and management; the development of methods for artificial reforestation, including both nursery practice and field planting; the determination of the best methods of cutting for the remaining virgin stands to insure reforestation without the expense of artificial planting. To sum up, the problems to be covered must develop the whole technical basis for the practice of forestry for the species, types, and conditions of this region. They must necessarily cover the problems of National Forest administration, the handling of privately owned commercial tracts, and the best practice for farm woodlots.

IN THE ROCKY MOUNTAINS.

The various Rocky Mountain ranges extend a distance of 1,400 miles from Canada to Mexico, and 900 miles from South Dakota to Nevada, and include extremely diversified conditions. The forests of this large region vary from the western white-pine stands of northern Idaho, of extremely rapid growth under climatic conditions approximating those of the Pacific coast, to the yellow-pine stands, which thrive on a much smaller precipitation, and, finally, to the piñon and juniper woodlands of Arizona and New Mexico, which mark the lower altitudinal limits of tree growth. The region embraces a forest area of 61,000,000 acres. It will require for the satisfactory solution of its problems three forest experiment stations, the first covering central and northern Idaho, eastern Washington, and western Montana; the second, the Central Rocky Mountain region; and the third, Arizona, New Mexico, and southern Utah. The Rockies still contain almost 40,000,000 acres of virgin timber, in which the reckless methods of cutting which have been followed throughout the East should not be permitted. Artificial reforestation will probably be necessary to put timber upon approximately 5,000,000 acres of waste land. Slightly less than 20,000,000 acres contain partially productive stands of young timber.

NORTHERN ROCKY MOUNTAINS.

The northern Rockies, together with the West coast forests, form the only timber regions of the United States which promise to be more than self-supporting in lumber cut in 1930. It is of obvious importance to keep the region at full growing capacity, not only from the standpoint of the general market but also from the standpoint of local requirements. The various mining districts of the northern Rockies—Butte, Cœur d'Alene, and others—are important consumers of timber, and further agricultural development will be dependent in no small degree upon cheap and abundant timber supplies. Northern Idaho and northwestern Montana grow at its optimum the western white pine, very similar in its properties to the eastern white pine which was once believed to be inexhaustible, but is now rapidly disappearing from our markets. The northern Rockies also support stands of such species as Engelmann spruce, which are suitable for pulp and paper manufacture. Because of the favorable climatic conditions and the extremely rapid timber growth which is possible, it is one of the regions in which the Forest Service would like to concentrate its efforts at reforestation.

The fire problem in the heavy and extremely sensitive western white pine forests is one of the most critical in the United States and, in fact, in the entire world. Investigation of factors which underlie more effective fire protection must therefore be greatly emphasized in the work of a forest experiment station.

A small forest experiment station maintained in the region prior to July 1, 1920, which was reopened on July 1, 1921, has already demonstrated its value by working out reasonably successful methods of artifical reforestation for such important species as western white pine. Seed storage in the duff of western white pine stands has been found somewhat similar to that described for the Douglas fir forests, and enough information as a basis for fire protection has been gathered to emphasize the need for continuing and greatly enlarging this class of work. There is work ahead in the determination of the best methods of cutting. Brush disposal, because of the large quantities left in logging operations, is as difficult and important as in the Pacific Northwest. The northern Rockies contain much larger private holdings than either the central or southern portions, and the results of forest investigations are therefore needed as a basis for private as well as National Forest practice.

CENTRAL ROCKY MOUNTAINS.

The timber cut of the central Rocky Mountains is already below local requirements, and it is increasingly important that the margin between production and consumption be reduced to a minimum. The maintenance of existing industry and the inevitable future expansion in agriculture, mining, and railroad construction will demand a larger timber output. The future of agriculture in the central Rockies is also dependent upon the forests for the regulation of stream flow for irrigation. The staff of the station which was maintained in this region until July 1, 1920, but which has now been reduced to a single technical man, investigated the planting of the Nebraska sand hills, and a number of questions relating to these operations still require attention. Other problems relate mainly to the extensive lodge pole pine forests of the central Rockies and to the eastern outpost of the western yellow pine forests in the Black Hills of South Dakota. The information which a station can obtain is needed primarily in national forest administration, although the privately owned forests should not be ignored.

SOUTHERN ROCKY MOUNTAINS.

Arizona and New Mexico, like the central Rockies, do not now produce their full timber requirements, the use each year being two to three times the cut. Here also the water supply for irrigation is of primary importance, and the forest must be managed from this standpoint as well as for timber. The first forest experiment station in the United States was established in Arizona in 1908, and though the major portion of the work has been discontinued, a good beginning was made here in solving a problem of forestation almost as difficult as that of the Nebraska sandhills. To secure young growth naturally is proving equally difficult, and 20 years may pass after logging operations without even the beginning of a young stand. Here also a good start had been made in investigations (see fig. 8), but much remains to be done in the development of methods of cutting, brush disposal, and regulation of grazing, which will insure satisfactory young forests within a reasonable time after cutting. Research, formerly confined almost exclusively to western yellow pine stands, must as soon as possible cover also the other forests of the region. Results of the work which a station should do will benefit National Forest administration mainly, but private holdings growing out of Spanish and railroad land grants are also extensive.

ON THE PACIFIC COAST.

The forests of the Pacific Coast States, from the standpoint of existing supply, are the most important in the United States, since they contain approximately one-half of all our remaining timber.

To the stands of Washington, Oregon, and California must be added 70,000,000,000 feet in the Alaskan Panhandle. Pacific coast forest conditions vary widely as do those of the Rocky Mountains. Conditions vary from the tide-water forests of the Alaskan Panhandle of spruce and hemlock growing under a precipitation sometimes reaching 190 inches per year, through the heavy Douglas fir forests of the lower altitudes of Washington and Oregon, the true fir forests of the upper mountain slopes, the yellow pine forests culminating in the yellow pine-sugar pine stands of California, the redwoods of both the coast and the Sierra types, and finally, to the brush or chaparral stands most extensive in southern California. The stations required—one in California and a second in the Pacific Northwest—must deal with the problems of a forest area of nearly 60,000,000 acres, exclusive of Alaska. Of this total, 6,500,000 acres are now wholly waste, and artificial planting on much of it will prove extremely difficult, because, after repeated fires, the land has been seized by brush and chaparral. Depletion has already gone so far that the country can not afford to allow on the 40,000,000 acres of remaining virgin timber of the coast States the disastrous methods of cutting of the past in both eastern and western forests.

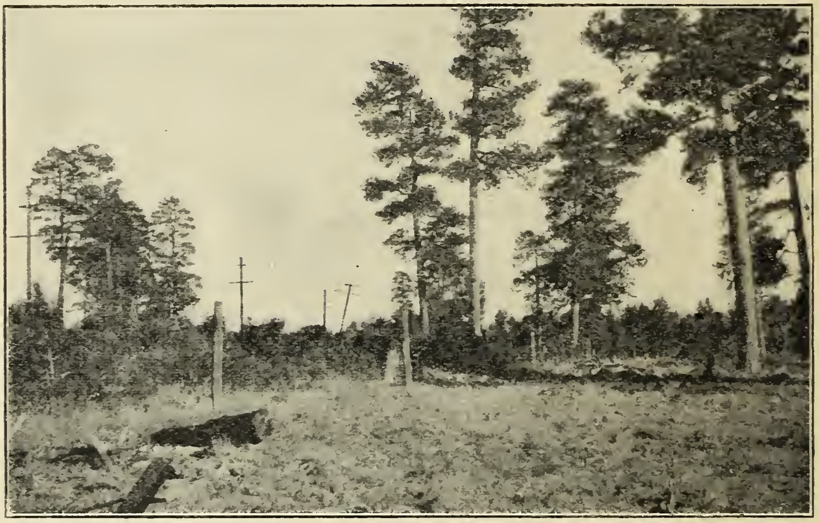

FIG. 8.—An investigative area showing the effect of unrestricted sheep grazing upon cut-over western yellow-pine reproduction in the Southwest. The area inside the fence with the splendid young stand has been protected.

CALIFORNIA.

The nature of the problems of the California station has already been indicated in part. Methods of cutting and of artificial reforestation must be developed for the valuable redwood, Jeffrey, western yellow, and sugar-pine stands which occupy so large a part of the forest area of the State. Outside the region directly involved, the importance of proper management for chaparral stands is little appreciated. The highly developed agriculture of southern California, for example, with citrus orchards selling for as much as $6,000 per acre, depends for the water to supply its irrigation upon the streams whose watersheds are covered almost exclusively with chaparral. The permanence of this agricultural industry, as well as its future development, depends upon securing a proper regulation of stream flow and upon preventing the erosion which follows the destruction of chaparral stands, and which is in no small measure responsible for the disastrous floods of the region. A single rain upon burned watersheds, followed by erosion and the literal burying of agricultural lands, has caused damage amounting to several millions of dollars.

Watershed protection is important in California, from the standpoint of municipal water supply. Los Angeles now draws its supply from the Sierras, a distance of 209 miles, and a similarly ambitious project to supply San Francisco is under construction.

The fire protection problem is of first importance throughout the entire State, and the basis for improved methods in many of its phases can be supplied only through the work of a local forest experiment station.

PACIFIC NORTHWEST.

With the exception of one census year, the State of Washington has stood first in lumber production since 1905. Oregon, tenth in 1907, had reached third place in 1918. No other State can compare in total stand with Oregon, with its total of nearly 500,000,000,000 feet, although Washington is hardly a bad second with a total of more than 330,000,000,000. Lumber production in the Pacific Northwest has been one of the greatest industries since early days; in fact, the prosperity of these States is measured in terms of the prosperity of the lumber industry.

The Alaskan Panhandle with its water power, its numerous mill sites on protected water channels, and its 70,000,000,000 feet of excellent pulp timber, now stands at the threshold of a pulp and paper industry which in a comparatively few years should rival that of Scandinavia. This region can be made to supply in perpetuity at least one-fourth of the present total pulp requirements of the United States, or one-half of our present newsprint requirements. Alaska offers a great opportunity to develop an industry which will go far toward making us independent of Canadian and other foreign supplies, but as yet no work has been done to develop methods of cutting that will assure a permanent timber growth.

The lines of work for the Pacific Northwest and Alaska with respect to fire protection, tree planting, silviculture, and timber management must parallel under different conditions and with different species those already outlined for the other forest regions of the United States.

WHAT ADEQUATE FOREST EXPERIMENT STATIONS WOULD COST.

The place of forest experiment stations in American forestry and the urgent need for them, if the timber-growing industry is to support the wide range of other industries dependent upon it, has hitherto been lost sight of or has been viewed in too small a way. Gradually the work at the existing stations should be enlarged and new stations established until the series of 10 indicated are provided. The problems of each of the more important regions are of such importance as to require a station with a technical staff of 12 men. The staff, for example, in the Pacific Northwest would include a director, two men for work on fire problems, two men for Douglas fir, two for yellow pine, two for Alaskan forests, one man on tree planting, and two for all other problems, including such forest types as the true firs and the coast forests of Washington and Oregon. It would be necessary to provide also for temporary technical help, labor, and clerical work, for various miscellaneous expenses, supplies, and equipment, and probably for the construction and maintenance of some buildings. Stations for other regions would require a technical staff of from 6 to 12 men. This plan will involve ultimately a yearly outlay of approximately $50,000 for each station in the Northeast, the southern pine belt, the northern Rockies, and the Pacific Northwest; and from $30,000 to $45,000 each for the stations in the Lake States, the Alleghanies, the Southern Appalachians, the central and southern Rockies, and in California. Provision for a small central laboratory and for supervision would bring the yearly cost of the whole program up to about $500,000. This, for the forest area of the United States, would mean annually an annual expenditure of about one-tenth of 1 cent per acre for forest investigations.

Other nations have been spending on forest investigations a good deal more in proportion to the size of their forest area and have found that it is good economy. The annual prewar expenditure of Germany and Switzerland, which had a background of centuries of forestry, on a proportional forest land basis, were at the rate of $1,500,000 and $3,000,000, respectively. Java was spending on its tropical forests at the rate of $5,000,000 (see fig. 9). Even these figures do not take into account the fact that the prewar dollar had a much greater purchasing power than the present dollar.

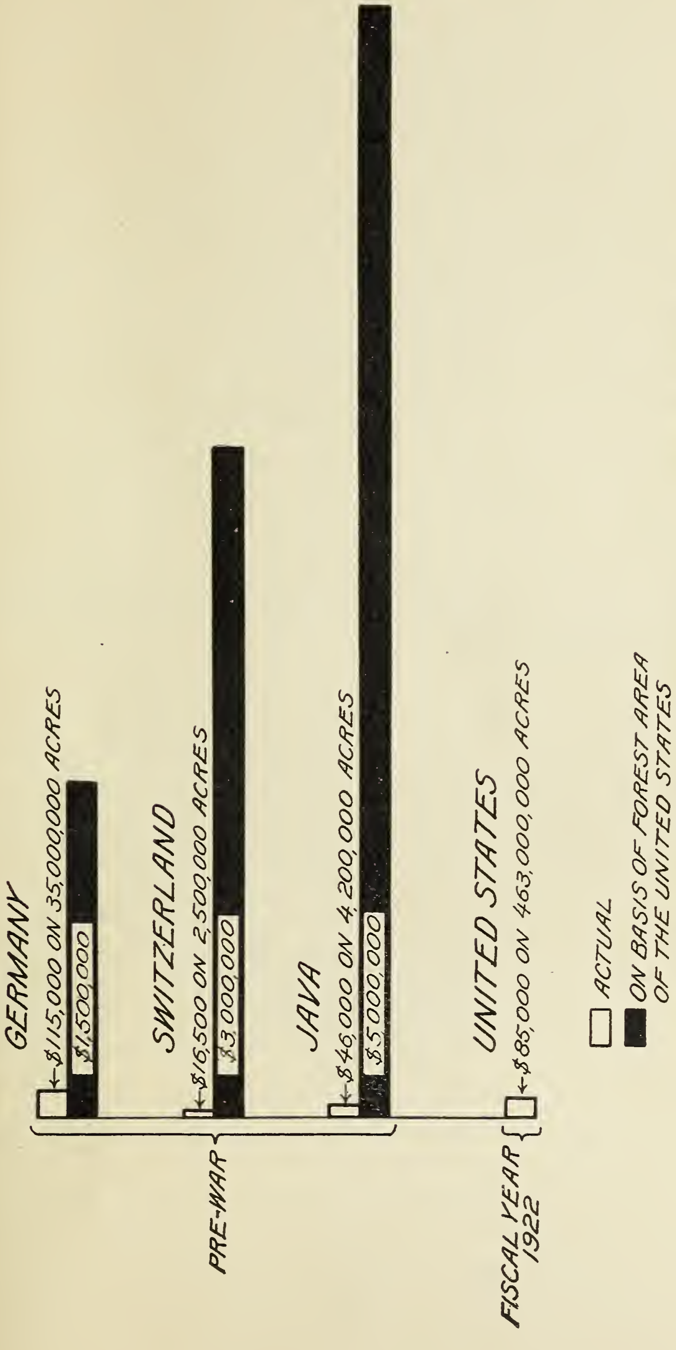

Fig. 9.—Actual and proportional expenditures for forest experiment stations

The problems for the solution of which these funds would be used are tremendous both in size and scope. Our forest investigations must deal with a forest area twice that of all Europe, exclusive of prewar Russia. They must provide the scientific basis for at least quadrupling the timber growth on fully one-fourth of the land area of the United States. The normal lumber output of the United States of 40,000,000,000 board feet is more than half of the world's production, and our own consumption is proportionately great. We produce 35 per cent or more of the world's wood pulp, and we manufacture more than half of the world's paper. Our per capita consumption of 147 pounds of paper in 1920 is two or three times that of the most progressive European countries. Our per capita newsprint consumption of 40 pounds in 1920 had grown from three pounds in 1880. If, because of the unsatisfactory character of the data available, fuel be excluded, we cut approximately one-third of the wood products of the entire world. If forest experiment stations are to perform their proper function, they must be utilized to find out and demonstrate how to grow the timber necessary permanently to maintain this cut and consumption. Upon such use of experiment stations will depend in no small measure success in growing the timber necessary to meet our requirements of twenty-four and one-half billion cubic feet annually.

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